## REMARKS/ARGUMENTS

Claims 1-57 were pending in this application at the time the present Office Action was mailed. Claims 1, 2, 7, 16, 23, 34-39 and 40 have been amended in this response, and claims 4, 15, 26, 32 and 33 have been cancelled. Accordingly, claims 1-3, 5-14, 16-25, 27-32 and 34-57 are currently pending in this application.

In the Office Action mailed December 20, 2002, claims 1-57 were rejected and the specification was objected to. More specifically, the status of the application in light of this Office Action is as follows:

(A) The disclosure stands objected to because the Brief Description of the Drawings allegedly fails to comply with 37 C.F.R. § 1.74;

(B) Claims 1-57 stand rejected under the judicially created doctrine of obviousness-type double patenting as being unpatentable over claims 1-22 of U.S. Patent No. 6,471,913; and

(C) Claims 1-57 stand rejected under 35 U.S.C. § 103 as being unpatentable over U.S. Patent No. 6,072,163 to Armstrong et al. ("Armstrong") or U.S. Patent No. 6,073,681 to Getchel et al. ("Getchel").

The undersigned attorney wishes to thank the Examiner for engaging in a telephone conference on March 18, 2003. During that telephone conference, the outstanding claim rejections and the applied references were discussed. The following remarks summarize and expand upon the points raised during the March 18 telephone conference.

A. Response to the Objection to the Specification

The Brief Description of the Drawings for Figures 1-7 was objected to as allegedly failing to comply with 37 C.F.R. § 1.74 and MPEP § 608.01(f) and 608.02. Specifically, the brief description of these Figures appears to be objected to because the Figures are identified as containing several parts (e.g. Figures 1A-1G) while the description of the Figures allegedly applies to only one of the parts. The undersigned

attorney respectfully submits that the descriptions of Figures 1A-1G, 2A-2D, 3A-3F, 3G-3J and 4A-7B apply to all of the subparts of these Figures. Accordingly, MPEP § 608.01(f), which applies "if only Figure 1A is described in the brief description" does not apply to the present specification. Accordingly, the objection to the specification should be withdrawn.

B. Response to the Double Patenting Rejection

Claims 1-57 were rejected under the judicially created doctrine of obviousness-type double patenting as being unpatentable over claims 1-22 of U.S. Patent No. 6,471,913. The enclosed terminal disclaimer overcomes the double patenting rejection and accordingly, the double patenting rejection should be withdrawn.

C. Response to the Section 103 Rejections

Claims 4, 15, 26, 32 and 33 have been cancelled. Accordingly, the Section 103 rejections of these claims are now moot. The following discussion addresses the rejections of the remaining pending claims.

1. Claim 1

Claim 1 was rejected as being obvious in light of Getchel or Armstrong.

a. The Invention

The invention is directed generally toward apparatuses and methods for thermally processing a microelectronic workpiece. In a particular aspect of the invention, the apparatus includes a workpiece support positioned to engage and support a microelectronic workpiece, and a heat source having a solid engaging surface positioned to engage a surface of the microelectronic workpiece. Vacuum aperture portions of the heat source can be coupled to a vacuum source to draw the microelectronic workpiece tightly against the solid engaging surface, and the solid engaging surface can be generally continuous between the vacuum aperture portions. Accordingly, heat can be effectively and efficiently conducted to the workpiece (during heating) and from the workpiece (during cooling) as a result of the intimate contact

between the microelectronic workpiece and the heat source. The effective and efficient thermal transfer characteristics of this arrangement reduce the time required to thermally process the workpiece and produce more reliable and repeatable thermal processing results.

Claim 1 includes the features described above and apparatuses having these features can accordingly achieve the above benefits. For example, claim 1 is directed to an apparatus for thermally processing a microelectronic workpiece and includes a workpiece support positioned to engage and support the microelectronic workpiece, as well as a heat source having a solid engaging surface positioned to engage the surface of the microelectronic workpiece. The heat source has a plurality of vacuum aperture portions coupleable to a vacuum source, with the solid engaging surface being generally continuous between the vacuum aperture portions. A heat generator is attached directly to and/or integral with the heat source, and at least one of the heat source and the workpiece support is movable relative to the other between a first position with the microelectronic workpiece contacting the engaging surface and a second position with the microelectronic workpiece spaced apart from the engaging surface.

b. The Prior Art

Armstrong discloses in Figure 1A a bake/chill apparatus 10 having stationary support pins 19 that carry a wafer 12. A cooling member 26 is positioned below the wafer 12, and a bake plate 20 moves upwardly and downwardly between the wafer 12 and the cooling member 26. The bake plate 20 includes a wafer-supporting first major surface 22 that "preferably includes a plurality of protuberances 56 that minimize the direct physical contact area, and help ensure a consistently-sized gap 62, between bake plate 20 and semiconductor device 12" (Armstrong at column 12, lines 37-41). Accordingly, "with this approach, the total contact area between semiconductor device 12 and bake plate 20 is so small as to be negligible, yet semiconductor device 12 (and annular member 40 if present) is adequately supported" (Armstrong at column 13, lines 9-13).

Getchel discloses in Figures 2 and 7 a chuck 10 composed of components that are supported in "a non-constraining fashion such that lateral forces due to thermal expansion effects can overcome the clamping forces . . . and layers of the chuck 10 can move substantially continuously relative to each other" (Getchel at column 6, lines 32-37). The chuck 10 has an upper support 26 (that apparently supports a wafer), a ceramic substrate 28 beneath the upper support, a heat sink 14 beneath the substrate 28, and a heater 16 beneath the heat sink 14. The heater 16 "can be adhered to the bottom surface of the heat sink 14 such as by a vulcanizing process or by epoxy bonding" (Getchel at column 7, lines 52-53). Getchel further discloses:

> "[the] vulcanization process involves applying an adhesive to the heat sink 14 and/or heater 16 and attaching the two using the adhesive. Next, the attached heater and heat sink are subjected to heating under pressure to cure the adhesive. The result is good thermal conduction between the heater 16 and the heat sink 14" (Getchel at column 7, lines 60-65).

Referring now to Figure 7, a metal backing plate 419 can be positioned beneath a heater 416 and "a resilient, compressible (spring-like) insulating paper 417 is applied to the bottom of the heater 416" between the heater 416 and the backing plate 419 (Getchel at column 11, lines 29-31).

c. Analysis

A *prima facie* case of obviousness under 35 U.S.C. § 103 requires that the prior art reference or references teach or suggest all the claim limitations, that there be some suggestion or motivation to modify or combine the reference teachings, and that there be a reasonable expectation of success (MPEP at § 2142). As discussed during the March 18, 2003 telephone conference, the applied references fail to support a *prima facie* case of obviousness with respect to claim 1. For example, Armstrong fails to disclose or suggest a heat source "having a plurality of vacuum aperture portions...with the solid engaging surface being generally continuous between the vacuum aperture portions." In fact, Armstrong explicitly teaches away from such a structure by disclosing a preferred configuration in which protuberances prevent contact between a microelectronic workpiece and an engaging surface of a heat source. Getchel similarly

fails to disclose or suggest such an arrangement and furthermore fails to disclose or suggest a workpiece support with "at least one of the heat source and the workpiece support being movable relative to the other between a first position with a microelectronic workpiece contacting the engaging surface of the heat source in a second position with the microelectronic workpiece spaced apart from the engaging surface." In fact, Getchel discloses a heater and heat sink that are adhesively bonded together. Accordingly, neither reference discloses or suggests the features of claim 1. Rather than providing the requisite motivation to modify or combine the references to include the features of claim 1, each reference instead teaches away from the features of claim 1. Therefore, the Section 103 rejection of claim 1 should be withdrawn.

Claims 3, 5, and 6-14 all depend from claim 1. Claim 40 has been amended to depend from claim 1 and claims 41-50 depend from claim 40. Accordingly, these claims are patentable over the applied references for the reasons discussed above and for the additional features of these dependent claims. Therefore the Section 103 of these claims should be withdrawn.

2. Claim 2

Claim 2 has been amended to be in independent form.

a. The Invention

Another aspect of the invention is an apparatus for thermally processing a microelectronic workpiece that includes, in addition to a workpiece support and a heat source, a first heat sink that moves between a first position in which it is spaced apart from the heat source and a second position in which it is engaged with the heat source. A second heat sink is engaged with the first heat sink when the first heat sink is in its second position. An advantage of this arrangement is that the first heat sink can cool both the heat source and the microelectronic workpiece in a controlled manner during the cooling portion of an annealing cycle by contacting the heat source while the workpiece is engaged with the heat source. When the first heat sink moves away from the heat source (for example, while the heat source heats the microelectronic

workpiece during a heating portion of the cycle), the first heat sink can simultaneously be cooled by the second heat sink prior to reengaging the heat source during a subsequent cooling portion of the cycle. Accordingly, the second heat sink can cool the first heat sink when the first heat sink is not itself cooling the heat source and workpiece.

Claim 2 includes the features described above and accordingly apparatuses having these features can achieve the benefits described above. In particular, claim 2 includes the first and second heat sink described above, a supporting frame, a first member to support the heat source, a second member to support a cover that forms an at least partially enclosed chamber around the microelectronic workpiece, and actuators to move the first heat sink and the cover.

b. The Prior Art

Getchel and Armstrong are described above with reference to claim 1.

c. Analysis

Neither Armstrong nor Getchel disclose or suggest the use of multiple heat sinks to cool a microelectronic workpiece, with a first heat sink moving back and forth between a heat source and the second heat sink. Both Armstrong and Getchel disclose only a single heat sink. While Armstrong discloses a heat sink that moves relative to the heat source between an engaged position and a disengaged position, Armstrong fails to disclose or suggest a second heat sink to which the first heat sink can discharge heat when it is disengaged from the heat source and microelectronic workpiece. Accordingly, the applied references fail to support a *prima facie* case of obviousness with regard to claim 2 and the Section 103 rejection of claim 2 should be withdrawn.

3. Claim 16

Claim 16 has been amended to be in independent form.

a. The Invention

Another aspect of the invention includes an apparatus for thermally processing microelectronic workpieces that includes first and second thermal processing chambers, each having a workpiece support positioned to engage and support a microelectronic workpiece, and each having a heat source sized to transfer to the microelectronic workpiece heat sufficient to thermally process the microelectronic workpiece. The first chamber is positioned above the second chamber such that a portion of the first chamber between the first and second chambers is common to the second chamber and defines a lower portion of the first chamber and an upper portion of the second chamber. An advantage of this arrangement is that multiple chambers can be stacked one above the other in an integrated fashion so that the volume occupied by the chambers is reduced. Claim 16 includes the foregoing features and accordingly apparatuses having these features can achieve the foregoing benefits.

b. The Prior Art

Getchel and Armstrong were described above. Although not relied upon by the Examiner in the present Office Action, U.S. Patent No. 4,979,464 to Kunze-Concewitz ("Kunze-Concewitz") discloses an apparatus for treating wafers. The apparatus may include stackable containers forming compartments 41, each of which houses a treatment station for a wafer 14. In an exemplary embodiment, a magazine case 42 forms compartments 41 separated by partitions 43. Each compartment 41 receives a drawer 47, with each drawer 47 serving as a treatment station for one wafer 14 (Kunze-Concewitz at column 5, lines 35-49).

c. Analysis

The applied references fail to support a *prima facie* case of obviousness under Section 103. Neither Armstrong nor Getchel disclose multiple thermal processing stations stacked one above the other. Kunze-Concewitz discloses stacked compartments for treating wafers, but fails to disclose or suggest a common portion of the chambers that can define a lower portion of one chamber and an upper portion of the chamber above. In fact, Kunze-Concewitz teaches away from such arrangement by

disclosing compartments 41 that are separated by partitions 43 so that each can receive an independent drawer 47. This arrangement "enables easy removal and cleaning of the treatment stations" (Kunze-Concewitz at column 3, lines 33-34). Accordingly, a device which includes portions common to both the upper and lower chambers would defeat the stated purpose of Kunze-Concewitz by reducing or eliminating the ability to remove each station independently. Therefore, rather than providing the requisite motivation to combine or modify the references to include the features of claim 16, the references instead teach away from these features. Accordingly, the Section 103 rejection of claim 16 should be withdrawn.

Claims 17-22 depend from claim 16. Accordingly, these claims are patentable over the applied references for the reasons discussed above and for the additional features of these dependent claims. Therefore, the Section 103 rejection of these claims should be withdrawn.

4. Claim 23

Claim 23 has been amended to include the features of claim 32.

a. The Invention

Still another aspect of the invention is an apparatus for thermal processing of a microelectronic workpiece that includes a workpiece support, a heat source, and a heat sink position proximate to the heat source to selectively transfer heat from the heat source for cooling the heat source and the microelectronic workpiece. At least one of the heat sink and the heat source is movable relative to the other between a disengaged position and an engaged position. The heat sink has an engaging surface that is compressible between a non-compressed configuration (when the heat sink is disengaged from the heat source) and a compressed configuration (when the heat sink is engaged with the heat source). Accordingly, the compressible engaging surface of the heat sink can provide intimate thermal contact between the heat sink and the heat source when these two components are engaged with each other. Claim 23 includes

the foregoing features and accordingly apparatuses having the features of claim 23 can achieve the foregoing benefits.

b. The Prior Art

Armstrong and Getchel were described above. In particular, Getchel discloses a resilient compressible insulating paper between a heater (which is fixedly attached to a heat sink) and a metallic backing plate.

c. Analysis

The applied references fail to support a *prima facie* case of obviousness with respect to claim 23. For example, while Getchel discloses a compressible material attached to a heater, Getchel fails to disclose or suggest a compressible substance that engages with and disengages with movable components such as the heat sink and heat source of claim 23. In fact, Getchel teaches away from such an arrangement because Getchel's heat source and heat sink are permanently attached to each other, as described above with reference to claim 1.

Assuming for the sake of argument that Armstrong's bake plate 20 corresponds in part to the heat source of claim 23, and Armstrong's cooling member 26 corresponds in part to the heat sink of claim 23, Armstrong fails to disclose or suggest any type of compressible material between the bake plate 20 and the cooling member 26. Accordingly, the Section 103 rejection of claim 23 should be withdrawn.

Claims 24, 25 and 27-31 depend from claim 23. Accordingly, these claims are patentable over the applied references for the reasons discussed above and for the additional features of these dependent claims. Therefore, the Section 103 rejection of these claims should be withdrawn.

Independent claims 51 and 56 include features generally similar to those discussed above with reference to claim 2, including a heat source, a first heat sink positioned to cool the heat source, and a second heat sink positioned to cool the first heat sink. Claims 52-55 depend from claim 51, and claim 57 depends from claim 56.

Accordingly, claims 51-57 are patentable over the applied references for the reasons discussed above and for the additional features of these claims.

5. Claim 34

Claim 34 has been amended to be in independent form.

a. The Invention

Yet another aspect of the invention is an apparatus for thermal processing a microelectronic workpiece that includes a workpiece support, a heat source having an electrical contact portion, and an electrically and thermally conductive connector engaged with the electrical resistance element. The connector is sized to generate electrical resistance heating at least equal to a loss of heat through the connector by thermal conduction and has an at least partially conical shape with a larger diameter toward one end than the other to achieve this result. An advantage of this arrangement is that the electrical resistance heater will be less likely to lose heat via the contact, which can create undesirable temperature gradients at the surface of the microelectronic workpiece. Accordingly, an apparatus having these features can more uniformly heat a microelectronic workpiece, for example, during annealing. Claim 34 includes the foregoing features and accordingly apparatuses having these features can achieve the foregoing benefits.

b. The Prior Art

Armstrong and Getchel were described above.

c. Analysis

Neither Getchel nor Armstrong disclose or suggest an electrically and thermally conductive connector having the features described above with reference to claim 34. In fact, neither reference provides any detail of the manner in which electrical current is supplied to the heat sources they employ. Accordingly, the Section 103 rejection of claim 34 should be withdrawn.

Claims 35-39 have been appended to depend from claim 34. Accordingly, these claims are patentable over the applied references for the reasons discussed above and for the additional features of these dependent claims. Therefore, the Section 103 rejection of these claims should be withdrawn.

In view of the foregoing, all the claims are patentable over the applied references. A Notice of Allowance is, therefore, respectfully requested. If the Examiner has any questions or believes a telephone conference would expedite prosecution of this application, the Examiner is encouraged to call the undersigned at (206) 287-3257.

Respectfully submitted,
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## APPENDIX

## VERSION WITH MARKINGS TO SHOW CHANGES MADE

**In the Claims:**

1. (Amended) An apparatus for thermally processing a microelectronic workpiece, comprising:

a workpiece support positioned to engage and support the microelectronic workpiece; and

a heat source having a solid engaging surface positioned to engage a surface of the microelectronic workpiece, the heat source having a plurality of vacuum aperture portions coupleable to a vacuum source, with the solid engaging surface being generally continuous between the vacuum aperture portions, the heat source further having a heat generator attached directly to and/or integral with the heat source, at least one of the heat source and the workpiece support being movable relative to the other between a first position with the microelectronic workpiece contacting the engaging surface of the heat source and a second position with the microelectronic workpiece spaced apart from the engaging surface, the heat source being sized to transfer heat to the microelectronic workpiece at least sufficient to thermally process a selected material of the microelectronic workpiece when the microelectronic workpiece is engaged with the heat source in the first position.

2. (Amended) An apparatus for thermally processing a microelectronic workpiece, comprising:

a workpiece support positioned to engage and support the microelectronic workpiece;

a heat source having a solid engaging surface positioned to engage a surface of the microelectronic workpiece, the heat source further having a heat

generator attached directly to and/or integral with the heat source, at least one of the heat source and the workpiece support being movable relative to the other between a first position with the microelectronic workpiece contacting the engaging surface of the heat source and a second position with the microelectronic workpiece spaced apart from the engaging surface, the heat source being sized to transfer heat to the microelectronic workpiece at least sufficient to thermally process a selected material of the microelectronic workpiece when the microelectronic workpiece is engaged with the heat source in the first position; ~~The apparatus of claim 1, further comprising:~~

a frame;

a first member fixed to the frame and supporting the heat source in a fixed position relative to the frame;

a first heat sink supported by the first member and movable relative to the first member between a first position with the first heat sink spaced apart from the heat source and a second position with the first heat sink engaged with the heat source;

a first actuator coupled between the ~~lower~~ first member and the first heat sink to move the first heat sink relative to the ~~lower~~ first member;

a second member fixed to the frame and supporting a cover, the cover being movable relative to the second member between a first position with the cover spaced apart from the first member and a second position with the cover engaged with the first member, the cover and the first member defining an at least partially enclosed chamber around the microelectronic workpiece when the cover is in the second position;

a second actuator coupled between the cover and the second member to move the cover between the first and second positions; and

a second heat sink fixed relative to the first member and coupled to a supply of cooling fluid, the second heat sink being engaged with the first heat sink when the first heat sink is in its second position.

7. (Amended) The apparatus of claim 1, further comprising first and second heat sinks with the second heat sink spaced apart from the heat source and coupled to a supply of cooling fluid and the first heat sink positioned between the second heat sink and the heat source, the first heat sink being movable relative to the ~~cooling member~~second heat sink between a first position with the first heat sink engaged with the second heat sink to cool the first heat sink, and a second position with the first heat sink engaged with the heat source to cool the heat source and the microelectronic workpiece when the microelectronic workpiece is engaged with the heat source.

16. (Amended) ~~The apparatus of claim 15 wherein the first chamber is positioned above the second chamber and wherein the portion common to the first and second chambers defines~~An apparatus for thermally processing at least first and second microelectronic workpieces, comprising:

a first thermal processing chamber having a first workpiece support positioned to engage and support the first microelectronic workpiece, the first chamber further having a first heat source sized to transfer to the first microelectronic workpiece heat sufficient to thermally process the first microelectronic workpiece when the first microelectronic workpiece is at least proximate to the first heat source; and

a second thermal processing chamber proximate to the first chamber and having a second workpiece support positioned to engage and support the second microelectronic workpiece, the second chamber further having a second heat source sized to transfer to the second microelectronic workpiece heat sufficient to thermally process the second microelectronic workpiece when the second microelectronic workpiece is at least proximate to the second heat source, and with the first chamber positioned above the second chamber such that a portion of the first chamber between the first and second chambers is common to the second chamber and defines a lower ~~surface~~ portion of the first chamber and an upper ~~surface~~ portion of the second chamber.

23. (Amended) An apparatus for thermal processing a microelectronic workpiece, comprising:

an apparatus support;

a heat source supported by the apparatus support;

a workpiece support positioned proximate to the heat source to engage and support the microelectronic workpiece relative to the heat source; and

a heat sink proximate to the heat source and positioned to selectively transfer heat from the heat source to cool the heat source and the microelectronic workpiece, at least one of the heat sink and the heat source being movable relative to the other between a disengaged position and an engaged position, the heat sink having an engaging surface that is compressible between an uncompressed configuration when the heat sink is disengaged from the heat source and a compressed configuration when the heat sink is engaged with the heat source.

34. (Amended) ~~The apparatus of claim 33 wherein~~An apparatus for thermal processing a microelectronic workpiece, comprising:

a workpiece support positioned to engage and support the microelectronic workpiece;

a heat source having an electrical resistance element and an electrical contact portion, the heat source being configured to transfer heat to the microelectronic workpiece at a rate sufficient to thermally process the microelectronic workpiece when the microelectronic workpiece is at least proximate to the heat source; and

an electrically and thermally conductive connector having a first end and a second end opposite the first end, the connector being engaged with the contact portion of the electrical resistance element toward the first end of the connector, the connector being coupleable to a source of electrical current toward the second end of the connector, a cross-sectional area distribution of the connector between the first and second ends and transverse to a flow of electrical current through the connector being sized

to generate electrical resistance heating at least equal to a loss of heat through the connector by thermal conduction, the connector ~~has~~ having an at least partially conical shape with a larger diameter toward the first end than toward the second end, ~~further~~ wherein an outer edge of the connector is curved in a plane parallel to an axis extending between the first and second ends.

35. (Amended) The apparatus of claim ~~33~~ 34 wherein the electrical terminal portion is positioned proximate to an outer edge of the microelectronic workpiece when the microelectronic workpiece is positioned on the workpiece support.

36. (Amended) The apparatus of claim ~~33~~ 34 wherein at least one of the heat source and the workpiece support is movable relative to the other between a first position with the microelectronic workpiece contacting the engaging surface of the heat source and a second position with the microelectronic workpiece spaced apart from the engaging surface.

37. (Amended) The apparatus of claim ~~33~~34, further comprising:

a base member supporting the heat source; and

a lid movable relative to the base member between an open position and a closed position with the lid and the base member positioned to receive the microelectronic workpiece therebetween when the lid is in the open position, the lid and the base member at least partially enclosing the microelectronic workpiece when the lid is in the closed position.

38. (Amended) The apparatus of claim ~~33~~ 34 wherein the heat source is sized to transfer sufficient heat to the microelectronic workpiece to anneal a selected material of the microelectronic workpiece when the microelectronic workpiece is at least proximate to the heat source.

39. (Amended) The apparatus of claim ~~33~~34, further comprising the microelectronic workpiece.

40. (Amended) ~~An~~ The apparatus of claim 1 wherein ~~for thermally processing a microelectronic workpiece, comprising:~~

~~a workpiece support configured to support the microelectronic workpiece; and~~

~~a~~the heat source ~~positioned proximate to the workpiece support and having~~has a first region configured to transfer heat to the microelectronic workpiece at a first rate per unit area of the microelectronic workpiece, the heat source further having a second region configured to transfer heat to the microelectronic workpiece at a second rate per unit area of the microelectronic workpiece, the second rate per unit area being greater than the first rate per unit area.